

Even and Uneven-Aged Forest Management

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Eastern Oklahoma contains about 4.7 million acres of commercial forest land. These forests have been relied upon in the past for many resources. Timber has been one of these important resources.

Many different methods exist for the management of Oklahoma's forests. Recently, the most productive of these forests have been intensively managed by clearcutting and other even-aged methods. While these methods have sound biological foundations, alternatives have been sought to improve the aesthetic result of timber harvest. This factsheet will present an overview of the management options available primarily for natural regeneration of Oklahoma's forests.

An understanding of the concepts of forest ecology and forest management will help provide a better understanding of regeneration methods. A good companion to this fact sheet which defines terminology is OSU Extension Fact Sheet F-5022, "Frequently Used Forestry and Natural Resource Terms for Landowners of Oklahoma," which is available at your local OSU Extension Center.

The Age of Trees in a Forest

One way to view the forest is by the age of trees. In forestry terminology, this is referred to as the age-class distribution of a forest.

Even-aged Forests

The simplest type of forest age class distribution is an even-aged forest. A plantation, established by planting one-year-old seedlings would be an example of a perfectly even-aged forest. This is illustrated in Figure 1.

Naturally regenerated even-aged stands often contain trees of different ages. When assessing a forest's age-class distribution, however, it is important to remember that a typical even-aged Oklahoma pine forest is often harvested for sawtimber between 50 to 80 years of age. In forestry terminology, this time period is referred to as the "rotation age." Professional foresters will characterize a forest as even-aged if the total range of ages present is less than 20 percent of the rotation age.

In an even-aged forest, trees are usually about the same height. This results in a single canopy and is illustrated in Figure 2. While total tree height is relatively uniform, the diameter of trees in an even-aged forest may vary widely. In a young forest where all trees are free to grow, their diameters may be

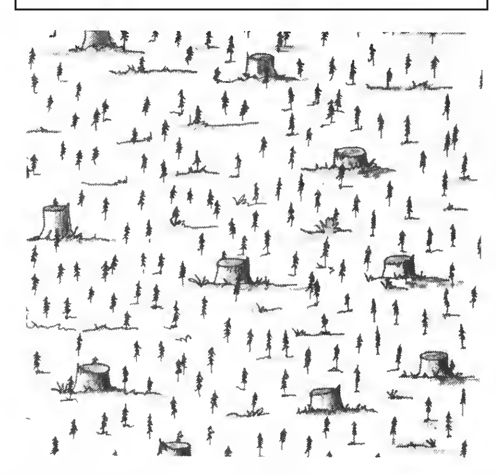


Figure 1. Planting an area with seedlings will normally result in an even-aged forest.

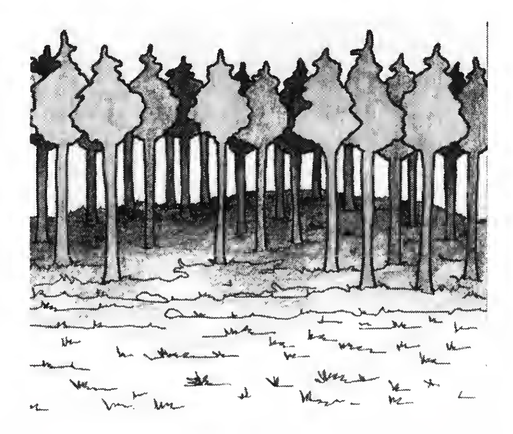


Figure 2. Even-aged pine forests consist of trees which are of equal age and roughly equal height. This results in a single canopy.

similar. In an older stand, however, crowding and competition begin to influence tree growth. Some trees will show dominance because of more favorable growing conditions or genetic factors. Other trees will grow more slowly and they will be suppressed. Thus, an even-aged forest may contain trees with a wide range of diameters. This is shown in Figure 3. Note that even-aged forests are sometimes composed of only one species of tree (shortleaf pine for example), but many times contain several species.

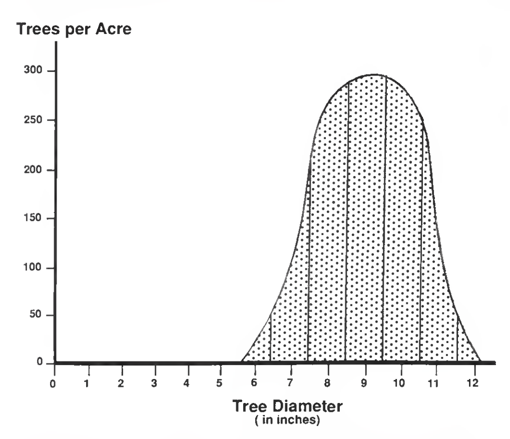


Figure 3. An even-aged forest will be made up of trees with different diameters. These diameters will be distributed in a "bell shaped" fashion about the average diameter. This type of diameter-distribution is indicative of even-aged forests.

Timber management in an even-aged forest is considered to be economically efficient since major operations require only one entry into a stand. Final harvests involve removing nearly all trees depending upon the regeneration method chosen. In an even-aged forest, foresters also have the opportunity to replant genetically improved seedlings which are more disease resistant, grow faster, and possess better timber and visual characteristics.

Two-aged Forests

A second type of age class distribution is the two-aged forest. A two-aged forest is made up of trees with two very distinct ages in the same stand. Two-aged forests will have two distinct canopy layers as shown in Figure 4.

The two-aged forest will often be composed of two tree species, one in each age-class. The older group, will be made up of types of trees that are able to regenerate barren, exposed areas following disturbances such as land clearing, fire, or clearcut timber harvesting. These tree types will normally only grow when full sunlight is available. Pines, cottonwoods, and sweetgum are examples of typical tree types in this group.

The second, younger group of trees is a more recent addition to the forest. These trees evidently were able to regenerate under the canopy of the first group. Only trees capable of growing under less than full sunlight will be found

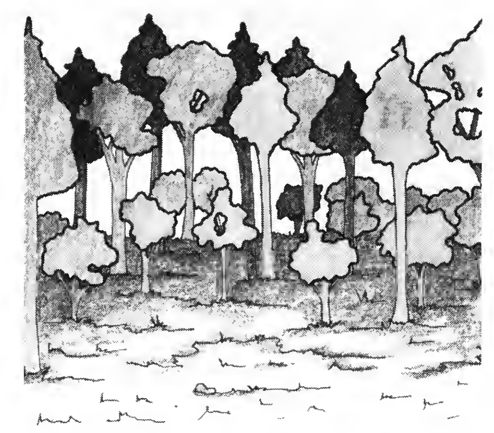


Figure 4. In a two-aged forest, there will be two distinct canopy layers. The overstory will be made up of shade intolerant trees such as pines. The understory layer will be made up of shade tolerant trees such as maples, dogwoods, and elms.

in this group. These types of trees are said to be "shade-tolerant" and include the maples, dogwoods, and elms. Other species may also occur which are somewhat shade tolerant such as oak, hickory, or ash.

Uneven-aged Forests

Consider a forest made up of three or more age-classes. Further, assume that each different age-class occupies roughly the same area. Larger trees need more room to grow and smaller trees need less. Since each age-class and corresponding diameter-class occupy the same area, there will be fewer big trees and many small trees. This situation describes an uneven-aged forest.

Looking at an three-aged forest from a diameter-class perspective, the difference between even and uneven-aged systems becomes clear. Uneven-aged forests typically have many small trees and very few big trees. Figure 5 presents the distinction.

In this type of forest, young trees will be growing in the shade of older, overtopping trees. An uneven-aged forest without human manipulation or natural disturbance will eventually be made up of mostly shade-tolerant tree types such as maple and elm which are capable of surviving and growing under these conditions. Assuming some natural disturbance occurs, intolerant and somewhat intolerant species may be part of an uneven-aged stand.

All-aged Forest

A special type of uneven-aged forest exists if a forest contains trees in each age class in one year increments from age one to the oldest. This is referred to by foresters as an "all-aged" forest. For this type of forest to come into existence, regeneration of new trees would need to occur every year. This rare forest situation is represented in Figure 6.

Timber management in an uneven-aged forest is more

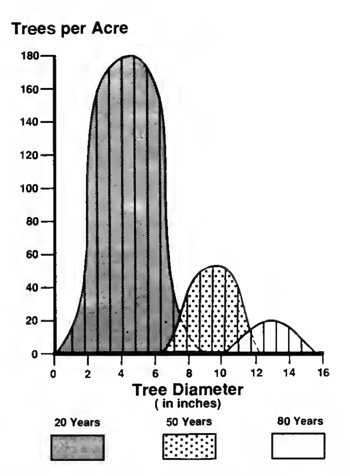


Figure 5. Diameter distribution of a three-aged forest. When a forest has three or more age classes it is considered to be uneven-aged.

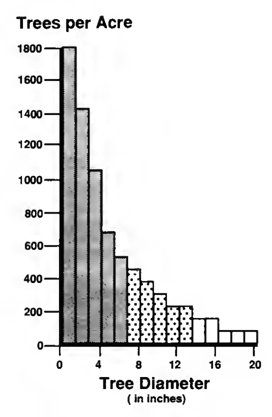


Figure 6. Diameter distribution of an "all-aged" forest. Please note that in an all-aged forest, there are many small trees and only a few big trees. Foresters call this curve the "inverted J" curve which is indicative of uneven-aged forests. For maintenance of this forest situation, trees would need to regenerate every year.

complex, and may be less economically efficient than managing even-aged forests. Care must be taken to remove trees without damaging trees that remain. Additional access and more frequent access is normally required in uneven-aged management. It is, however, sometimes perceived to be more aesthetically pleasing than clearcutting.

The previous discussion focused on unique characteristics of even and uneven-aged forests. In choosing a regeneration method, the landowner also determines what the age-class distribution of the future forest will be.

Natural Regeneration Techniques

Natural forest regeneration has been studied by foresters for centuries. From the Black Forest of Germany to our shortleaf pine forests of Eastern Oklahoma, natural regeneration techniques are well understood. Techniques will vary depending upon whether an even or uneven-aged forest is desired.

Even-aged regeneration

Foresters and other nature lovers of Eastern Oklahoma often observe young, even-aged, pine seedlings becoming established on disturbed or cleared sites. These cleared sites may be the result of construction, roadside maintenance, wildfires, agriculture, or planned timber harvest. These sites are characterized by exposed mineral soil, little or no hardwood competition and the presence of older, cone-bearing pine trees within 200-300 ft. of the site. Young pine will not become established, however, in the shaded conditions under a mature forest. Natural even-aged forests can be regenerated by three techniques including (1) clearcutting, (2) seedtree, and (3) shelterwood.

Clearcutting Method

If our goal is to regenerate a new stand of pine, or other type of intolerant tree, conditions must include exposed mineral soil with little competing vegetation. A source of seed is also needed.

A clearcut is an even-aged regeneration method. It involves harvesting all trees in a forest and establishing a new forest by planting or by natural regeneration. Openings in the forest to obtain natural regeneration will be limited in size by the ability of surrounding trees to provide seed to the site. Seeds of pines and other light-seeded trees may be dispersed up to 200 to 300 feet by the wind. Therefore, width of clearcuts must be limited if natural regeneration of pine is the desired objective. Figure 7 illustrates a naturally regenerated clearcut.

Foresters will normally prescribe some form of clearcutting if landowner objectives include intensive management of pine trees or other trees that cannot tolerate shade. Proper care taken in prescribing clearcuts ensures minimal soil erosion, maintains water quality, and improves habitat for many types of wildlife.

Seedtree Method

The seedtree method is another even-aged regeneration technique which utilizes seed trees directly on the site. It is similar, in many respects, to clearcutting. The major difference is that rather than remove all of the trees as with clearcutting, a few selected, seed-producing trees are left on the site. This provides a more uniform and reliable source of seed. Figure

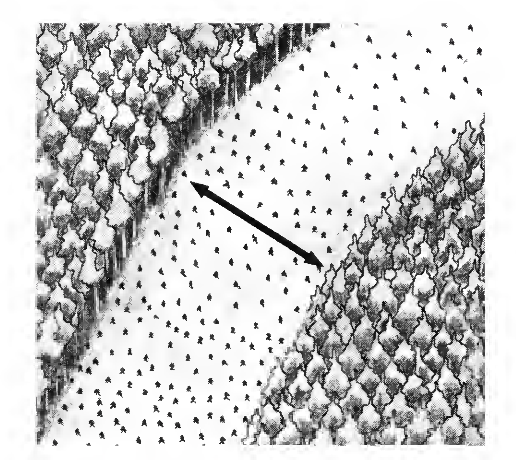


Figure 7. Clearcuts will naturally regenerate with shortleaf pine in Oklahoma if they are limited in width. Pine seed will normally disperse a distance of up to 5 times the height of seed trees. (Note arrow)

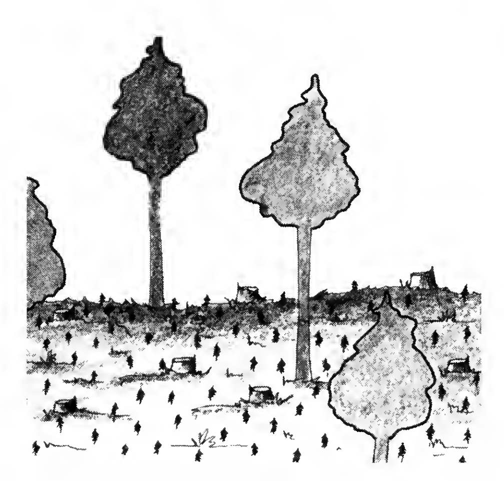


Figure 8. The seed tree method reserves a small number of trees on the site to provide seed.

8 illustrates the seedtree method.

Depending on tree species, size and expected seed production, the number of seed trees required will range from 5 to 20 per acre. The new stand will be even-aged. When a new stand has been established, the seed trees may be carefully harvested to minimize damage to the new seedlings.

Shelterwood Method

Another common method to naturally regenerate a forest is the shelterwood method. The unique aspect of this method is a stepwise harvest of the forest. This usually occurs using two or three harvests. Not all of the trees will be harvested before new regeneration has established under the "shelter" of shade from some of the remaining trees. Figure 9 illustrates this regeneration method.



Figure 9. The shelter-wood method of even-aged natural regeneration occurs with two or three partial harvests. This allows the regeneration to be somewhat sheltered by the remaining trees.

The timing of the harvest is such that regeneration is established over a short enough time period that the stand is even-aged. Remember that the definition of even-aged is a forest with an age range of less than 20 percent of rotation age.

With the shelterwood method, the timing and quantity of trees removed in a given step can be varied to create a wide range of conditions. For example, if the preferred type of tree to be regenerated requires nearly full sunlight, the first step may remove 60 percent or more of the overhead canopy. If the preferred type of tree will grow well under partial shade, the first cutting may remove only 25 to 50 percent of the overhead shade. As regeneration becomes established, the old stand is removed to allow more room for the new seedlings to grow. The shelterwood method can be used to regenerate most types of trees, with the exception of those

that can not tolerate any overhead shade.

Uneven-aged Regeneration

Selection Method

The selection method is the only method used to regenerate uneven-aged forests. The basic requirement of regeneration methods resulting in uneven-aged forests is the periodic harvest or natural death of a portion of the mature forest at regular intervals. To create the balanced uneven-aged distribution, harvest or natural death must be followed by successful regeneration.

There are two variations of the selection method, (1) single tree and (2) group selection.

1. Single-tree Selection

With this method, single mature trees are harvested from the forest. Annual application of the single tree selection method should regenerate a forest with an all-aged stand structure as illustrated in Figure 6.

Harvesting mature trees in a forest will create vacancies within the upper tree crown level. These vacancies will cause the surrounding trees to grow faster and these trees will eventually fill the crown void. New seedlings established in the opening will be exposed to shade. Only trees which survive in the shade will grow and develop under these conditions. Therefore, the single-tree selection method is not an efficient method to regenerate types of trees which need full sunlight, such as shortleaf pine. The ability to control tree species within the single-tree selection method is accomplished by mechanical or chemical treatment of unwanted trees.

To harvest a given volume of timber using single tree selection will require access to a greater area each year than under even-aged regeneration methods. This is because even-aged methods concentrate on intensive management and harvesting of smaller tracts at any one time.

The selection method is perceived to result in less site disturbance. Consideration, however, should be given to the frequency of forest entry with this method. Timber harvesting and competition control occurs on a more frequent basis as compared to even-aged regeneration methods.

2. Group Selection

In the group selection method, trees are harvested in small groups. The larger openings will have conditions, at least near the center of the opening, that are most suitable for regeneration of trees needing full sunlight. The dividing line between the group selection method and the clearcut method is not clearly defined. An opening of 1/10 to 2 acres is generally considered to be group selection. An opening greater than two acres is sometimes considered to be a "patch" clearcut. David Smith (1986) in The Practice of Silviculture, suggests that "the critical opening is probably about twice as wide as the height of the mature trees." This exemplifies the concept that there exists a continuum of regeneration techniques from which the landowner or forester must choose.

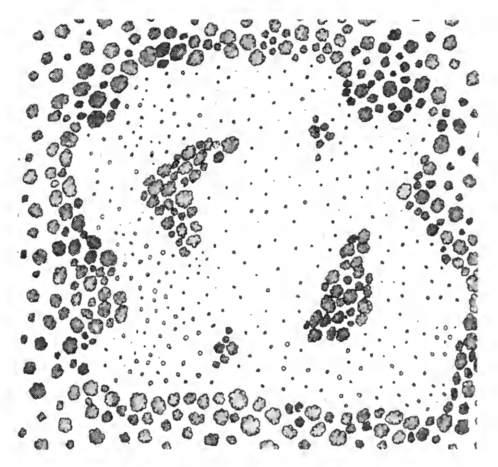
Figure 10 attempts to simplify the spectrum of regeneration methods.

Summary

Age class structure is an important characteristic of forests. The two broad age classes that characterize forests are even and uneven-aged. The three methods used to naturally regenerate even-aged forests are (1) clearcutting, (2) seedtree, and (3) shelterwood. Uneven-aged forests are regenerated by the selection method, which has two variations including (1) single tree selection and (2) group selection.

For specific information on management of your forest land, contact your local Oklahoma Department of Agriculture, Food, and Forestry - Forestry Division professional or your local OSU Extension Center.

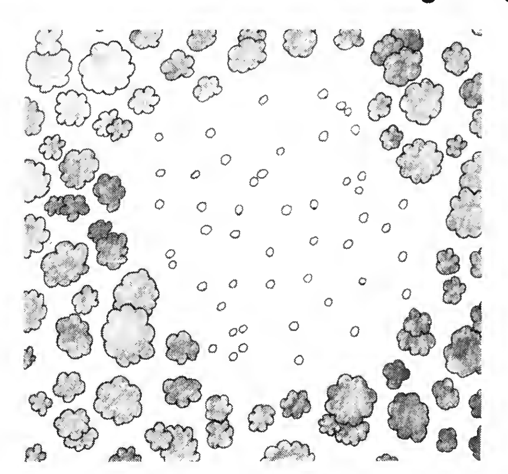
Even-aged regeneration methods



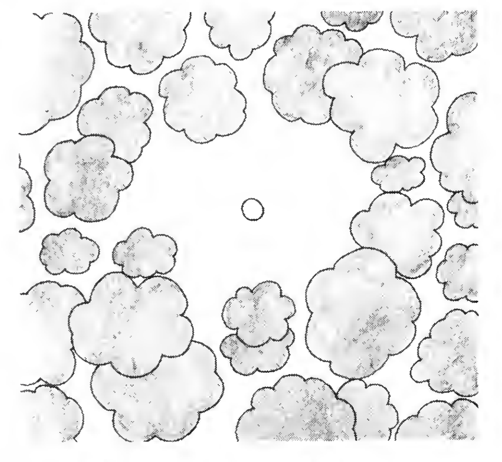
Clearcut opening with hardwood islands for wildlife -- 5 acres and larger in size.

Small patch clearcut opening -- 2-5 acres.

Uneven-aged regeneration methods



Group selection opening -- 1/10-2 acres.



Single-tree selection opening -- the area occupied by a single tree.

Figure 10. The spectrum of opening sizes to obtain forest regeneration varies widely.

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Credit is given to Suzie Radtke for the illustrations used in this publication.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 42 cents per copy. 0404